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Field Significance of Performance Measures in the Context of Regional Climate Model Verification

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The purpose of this study is to evaluate the skill of dynamically downscaled global climate simulations. We investigate a dynamical downscaling of ERA-Interim reanalyses using the Weather Research and Forecasting (WRF) model, coupled with the NOAH land surface model within the scope of EURO-CORDEX. WRF has a horizontal resolution of 11° and contains the following physics: the Yonsei university atmospheric boundary layer parameterization, the Morrison two-moment microphysics, the Kain-Fritsch-Eta convection and the Community Atmosphere Model radiation schemes. Daily precipitation and mean monthly 2 m temperatures are verified over Germany for summer and winter against high-resolution observation data from the German weather service for the first time.

Certain characteristics of statistical distributions are verified. Skill against the large-scale ERA-Interim data gives insight into the potential, additional skill of dynamical downscaling. To quantify it, we transform the absolute performance measures to relative skill measures against ERA-Interim. Their field significance is rigorously estimated and regions responsible for it are highlighted. Generally, added value of the downscaling is documented for the distributions of both variables and in both seasons. The downscaling outperforms the ERA-Interim representation of temperature in all aspects considered, except for variance in winter. Largest skill is detectable over regions of complex topography and change of surface roughness. The downscaling of precipitation is generally better in summer. While for weak and moderate precipitation as well as wet-day frequency, skill is significant only in summer, for high precipitation events it is significant in both seasons. In summer skill is generally uniform, while in winter it is concentrated in mountains. In winter significant deterioration is observable due to overestimation of wet-day frequency and small-to-moderate precipitation on windward sides, as well as underestimation of high precipitation events in valleys. This study demonstrates in a rigorous manner the clear additional value of dynamical downscaling over global climate simulations.